

CLAIMS:

1. A method for making a prototype plastic injection molded part, comprising the steps of:
 - providing a non-conductive plastic mold tool defining a mold cavity;
 - injecting a liquified ribbon of plastic material into the mold cavity at a pressure of less than 5000 psi, until the material fills the cavity;
 - curing the plastic material in the mold cavity to form the prototype part.
2. The method of claim 1, wherein the mold material is injected into the mold cavity using an extrusion head.
3. The method of claim 1 and further comprising:
 - heating the mold tool to approximately the extrusion temperature, prior to the injecting step.
4. The method of claim 1, wherein the injection pressure is less than 2000 psi.
5. The method of claim 1, wherein the injection pressure is less than 500 psi.
6. The method of claim 1, wherein the injection pressure is less than 20 psi.
7. The method of claim 1, and further comprising the step of:
 - clamping the mold tool to a fixture with a clamping force of less than or equal to 10 tons, prior to the injecting step.
8. The method of claim 1, wherein the injection step is an adiabatic process.
9. A method for making a prototype plastic injection molded part, comprising the steps of:
 - providing a non-conductive plastic mold tool defining a mold cavity;

injecting a thermoplastic material into the mold cavity as a liquified ribbon of material, at a pressure of less than 5000 psi, so that the production thermoplastic material fills the mold cavity; and

5 cooling the production thermoplastic material in the mold cavity to form the prototype part.

10. The method of claim 9 and further comprising the step of building the mold tool using a rapid prototyping technique, based on computer file data representing a desired prototype part.

10 11. The method of claim 10, wherein the mold tool is built in a fused deposition modeling machine.

12. The method of claim 11, wherein the building step and the injecting step are performed in the same fused deposition modeling machine.

15 13. The method of claim 9, wherein the injecting step is done in a fused deposition modeling machine.

14. The method of claim 9, wherein the mold material is injected into the mold cavity using a melt extruder.

20 15. The method of claim 14, wherein the melt extruder comprises a filament pump.

16. The method of claim 14, wherein the melt extruder comprises a piston pump.

17. The method of claim 14, and further comprising the steps of: positioning a sprue in the mold tool such that a dispensing end of the sprue is directed into the mold cavity; and attaching an inlet end of the sprue to a dispensing tip of the melt extruder;

25 wherein the thermoplastic material is injected from the melt extruder into the mold cavity via the sprue.

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18. The method of claim 14, wherein ultrasonic energy is induced in the extruder during the injecting step creating a thixotropic flow of thermoplastic.
19. The method of claim 9 and further comprising:
 - 5 heating the mold tool to approximately the extrusion temperature, prior to the injecting step.
20. The method of claim 9 and further comprising:
 - coating surfaces of the mold cavity with a release agent, prior to the injecting step.
- 10 21. The method of claim 9, and further comprising the step of: monitoring pressure in the mold cavity during the injecting step and responsively adjusting the injection pressure.
22. The method of claim 9, wherein the injection pressure is less than 2000 psi.
- 15 23. The method of claim 9, wherein the injection pressure is less than 500 psi.
24. The method of claim 9, wherein the injection pressure is less than 20 psi.
25. The method of claim 9, and further comprising the step of:
 - 20 clamping the mold tool to a fixture with a clamping force of less than or equal to 10 tons, prior to the injecting step.
26. The method of claim 9, and further comprising the step of:
 - 25 maintaining constant pressure on the mold tool during the cooling step to compensate for shrinkage of the prototype part and the mold tool.
27. The method of claim 9, wherein the prototype part is cooled in the mold cavity to a temperature approximating room temperature.
28. The method of claim 9, and further comprising the step of:
 - 30 vapor smoothing surfaces of the mold tool prior to the injecting step.

29. The method of claim 9, wherein the thermoplastic material is selected from a group consisting of ABS, polycarbonate, polystyrene, acrylics, amorphous polyamides, polyesters, polyphenylsulfone, polyphenylene ether, nylon, PEEK, PEAK, and blends thereof.

5 30. The method of claim 9, wherein the plastic mold tool is formed from a thermoplastic material comprising at least 50 weight percent of a thermoplastic selected from the group consisting of polycarbonate, polystyrene, acrylics, amorphous polyamides, polyesters, polyphenylsulfone, polysulfone, polyphenylene ether, nylon, PEEK, PEAK, poly(2-ethyl-2-oxazoline), and blends thereof.

10 31. The method of claim 30, wherein the thermoplastic forming the mold tool comprises a polyphenylsulfone-based resin.

32. The method of claim 30, wherein the thermoplastic forming the mold tool comprises a polyphenylsulfone-based resin and the injected thermoplastic is ABS.

15 33. The method of claim 9, wherein the injecting step is performed using a vacuum assist.

34. The method of claim 1, wherein the injection step is an adiabatic process.

20 35. A method for making a prototype plastic injection molded part, comprising the steps of:
providing a non-conductive, transparent plastic mold tool
defining a mold cavity
injecting a liquified ribbon of a photopolymer into the mold cavity at a pressure of less than 5000 psi, until the material fills the cavity;
25 curing the polymer in the mold cavity by exposing the polymer to light, thereby forming the molded prototype part.

36. The method of claim 35 and further comprising the step of:
heating the mold tool to approximately the extrusion temperature prior to the injecting step.

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37. The method of claim 35, wherein the polymer is injected into the mold cavity using a melt extruder.
38. The method of claim 35, wherein the injection pressure is less than 500 psi.
- 5 39. The method of claim 35, wherein the injection pressure is less than 20 psi.
40. The method of claim 35, wherein the injection step is an adiabatic process.
41. A method for making a prototype plastic injection molded part, 10 comprising the steps of:
 - providing a non-conductive plastic mold tool defining a mold cavity;
 - providing a supply of two or more reactant materials which form a thermoset resin when reacted together;
 - 15 mixing the reactant materials together;
 - injecting the reactant materials from an extruder into the mold cavity as a liquified ribbon of material, at a controlled pressure of less than 5000 psi, so that the reactant materials fill the cavity;
 - 20 heating the reactant materials in the mold cavity to form the molded prototype part; and
 - cooling the molded prototype part in the mold cavity.
42. The method of claim 41, wherein the injection pressure is less than 500 psi.
- 25 43. The method of claim 41, wherein the injection pressure is less than 20 psi.
44. The method of claim 41, wherein the injection step is an adiabatic process.